Project Title

ChromaVision: Color Detection and Correction for Color Blind Individuals

Topic

Addressing the Protanopia Color Perception Challenge: Leveraging Cutting-edge Machine Learning Models to Accurately Detect and Differentiate Colors in Real-world Environments for Individuals with Protanopia Color Vision Deficiency.

Additionally, Implementing Dynamic Color Correction Mechanisms to Optimize Visual Experience and Bridge the Gap in Color Perception.

Uniqueness

- This problem is unique because it bridges the gap between image analysis and individualized color perception for people with color blindness.
- Machine learning goes beyond simply identifying colors in an image. It needs to understand the user's specific color deficiency and then adjust the colors within the image to create a corrected version that caters to their visual needs.
- This personalized color correction enhances their ability to distinguish colors in images.

Dataset

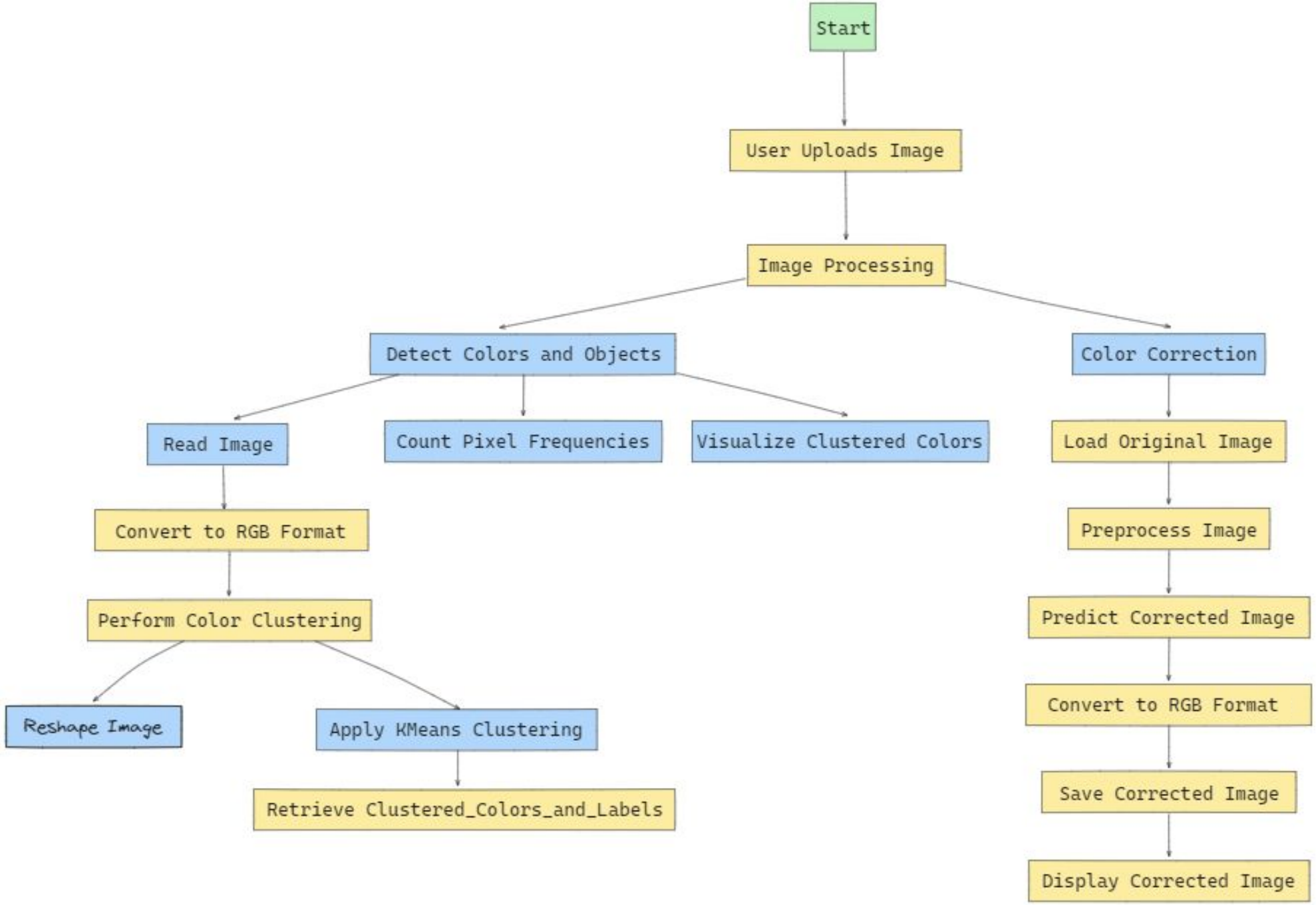
The CIFAR-10 dataset

Consists of 60000 32x32 colour images in 10 classes, with 6000 images per class. There are 50000 training images and 10000 test images.

Source : https://www.cs.toronto.edu/~kriz/cifar.html

Version:CIFAR-10 python version

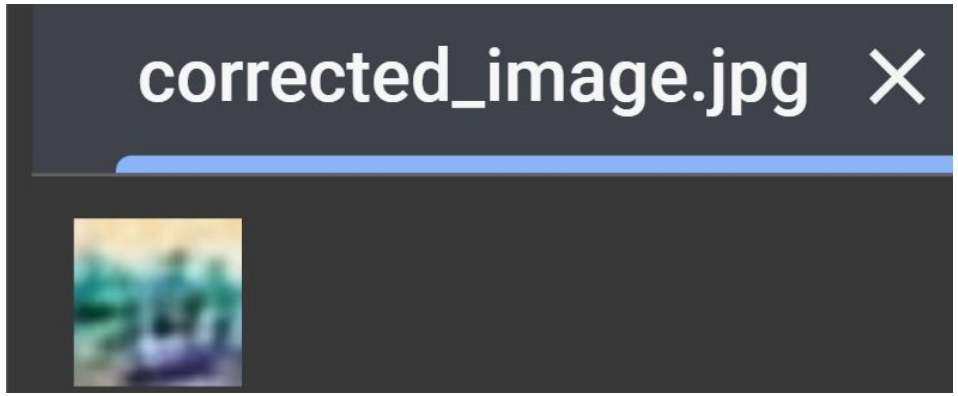
Size: 163 MB


Start
User Uploads Image
Image Processing
Detect Colors and Objects
Read Image
Count Pixel Frequencies
Visualize Clustered Colors
Convert to RGB Format
Perform Color Clustering
Reshape Image
Apply KMeans Clustering
Retrieve Clustered_Colors_and_Labels
Color Correction
Load Original Image
Preprocess Image
Predict Corrected Image
Convert to RGB Format
Save Corrected Image
Display Corrected Image

Final results so far

A metric Mean Squared Error (MSE) is indirectly used during training as the loss function.
The model is trained to minimize the MSE between the input and output images.

Final colour detection and colour correction for protanopia colour blindness:



Done vs Remaining to be done ?

No	Description	Done or To be done
1	Data Loading and Preprocessing: Loading the CIFAR-10 dataset and Normalizing pixel values to a range between 0 and 1.	Done
2	Model Architecture Definition: Defining a convolutional neural network (CNN) autoencoder architecture using TensorFlow's Keras API. The autoencoder consists of convolutional layers followed by max-pooling layers, a fully connected layer, and an output layer for image reconstruction.	Done
3	Model Compilation: Compiling the model using the Adam optimizer and mean squared error loss function.	Done
4	Model Training and saving : Training the model using the CIFAR-10 dataset. Using the input images as both input and target output for training. Saving the trained model to a file ('protanopia_model.h5') for later use.	Done
5	Color Clustering: Utilizing K-Means clustering for color clustering in images.	Done
6	Image Processing and Correction: Preprocessing uploaded images to ensure they are in the correct format and size for input to the model. Applying color correction using the trained model to correct colors in the uploaded images.	Done

Quantity and quality of work

no	Code functionality	% Complete	Runs without problem (Y/N)	If there are minor issues, indicate
1	Data Loading and Preprocessing: Successfully loads the CIFAR-10 dataset and preprocesses it by normalizing pixel values.	80%	Y	
2	Model Architecture Definition: Defines a convolutional neural network (CNN) autoencoder architecture using TensorFlow's Keras API.	100%	Y	
3	Model Compilation: The model is compiled using the Adam optimizer and mean squared error loss function.	100%	Y	
4	Model Training: The model is trained using the CIFAR-10 dataset, with input and target output being the same images.	100%	Y	
5	Color Clustering and Object Detection: Performs color clustering using K-Means and draws rectangles around each color cluster in the image.	90%	Y	
6	Image Processing and Correction: Processes uploaded images, applies color correction using the trained model, and displays the corrected image.	75%	Y	The corrected image has small size and poor quality due to limited GPU resources and computational power available for processing.

Top few learning

Serial No	Top learning in this project
1	Color Perception and Deficiency : Gained insights into the physiological mechanisms underlying color vision and the specific alterations in color perception experienced by individuals with color vision deficiencies, such as Protanopia.
2	Image Preprocessing : Worked with preprocessing techniques in computer vision, including color space conversions (e.g., RGB to LAB) and resizing, to prepare images for further analysis and model input.
3	Unsupervised learning : Understood unsupervised learning techniques like K-Means clustering for color quantization and segmentation, which involves grouping pixels in an image into clusters based on their color similarity.
4	Deep learning models : Understand the architecture and training process of CNNs, a class of deep learning models widely used in computer vision tasks, including image classification, segmentation, and color correction and other such models.

Reference papers (optional)

No	Paper Title	Authors	Publication details Year, published where
1	Deep Correct: Deep Learning Color Correction for Color Blindness	Gajo Petrovi´c and Hamido Fujita	2017 , Conference: The 16th International Conference on Intelligent Software Methodologies, Tools, and Technique
2	A Color Guide for Color Blind People Using Image Processing and OpenCV	Prasanna Kompalli ,Archana Kalidindi ,Janakidevi Chilukala, Kumudini Nerella Wajahath Shaik , Divija Cherukuri	2023 , International Journal of Online and Biomedical Engineering
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